

A STUDY ON THE TAXONOMY AND BIOLOGY OF THE NEOTROPICAL
TERMITE *NASUTITERMES AQUILINUS* (ISOPTERA, TERMITIDAE,
NASUTITERMITINAE) ¹

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ABSTRACT

The dimorphic soldier of *N. aquilinus*, a widely distributed species of the evergreen tropical florests of southeastern South America, is redescribed with a biometric study of the length and width of the head of 352 specimens of 1 colony. The worker digestive tube is studied, a soldier-nymph intercaste is described based on 4 individuals of 2 colonies, brachypterous neotenic reproductives are assigned and briefly described, notes on the biology and a study of the nest architecture are given, and 27 localities (from Brazil, Argentina and Paraguay) are reported for the species. The termitophilous staphylinid beetle *Termitosyne platygastra* is reported from 2 colonies of the termite. *N. a. rectifrons* is considered a junior synonym of *N. aquilinus*.

Key words: *N. aquilinus*, Nasutitermitinae, Termitidae, Isoptera, synonym, biometrics, distribution, neotenic, intercaste, worker gut, nest, biology, termitophiles.

INTRODUCTION

Nasutitermes aquilinus was described by Holmgren (1910: 286-289) in his monograph on the American *Eutermes* species, based on samples collected in the states of Santa Catarina and Rio Grande do Sul in the extreme south of Brazil; the author (l. c.: 193-196, 200) also furnished biometric information on the length and width of the head of the soldier. The occurrence of the species in Paraguay was reported by John (1920: 230), and peculiarities of its nest were described by Strelnikov (1920: 219-220), John (1920: 230-231) and Weidner (1955: 108; 1966: 213; 1970:41). Seevers (1957:303) listed the termitophilous Staphylinidae (Coleoptera) associated with the termite.

In this study the nomenclature for the mandibles and worker digestive tube follows Fontes (1980). Abbreviations for the institutions: BM (NH) British Museum (Natural History), London, England), IFPF (Institut für Pflanzenschutzforschung, Eberswalde, DDR), MZSP (Museu de Zoologia, Universidade de São Paulo, São Paulo, SP, Brazil), NHRM (Naturhistoriska Riksmuseet Stockholm, Sweden), ZIZM (Zoologisches Institut und Zoologisches Museum der Universität, Hamburg, BRD). The specimens studied are deposited in the MZSP and BM (NH).

1. Paper presented with the title "Systematic and biometric studies on *Nasutitermes aquilinus*, with the description of a soldier-nymph intercaste" as a poster at the symposium Biosystematics of Social Insects The International Union for the Study of Social Insects & The Systematics Association, January/1980, Paris. Financial grant from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (L. R. Fontes: proc. 40.2963/79).
2. Museu de Zoologia, Universidade de São Paulo, Caixa Postal 7172 01000 São Paulo, SP, Brazil. Financial grant from the Fundação de Amparo à Pesquisa do Estado de São Paulo (L. R. Fontes: proc. biol. 78/1149; P.S. Terra: proc. biol. 79/281).

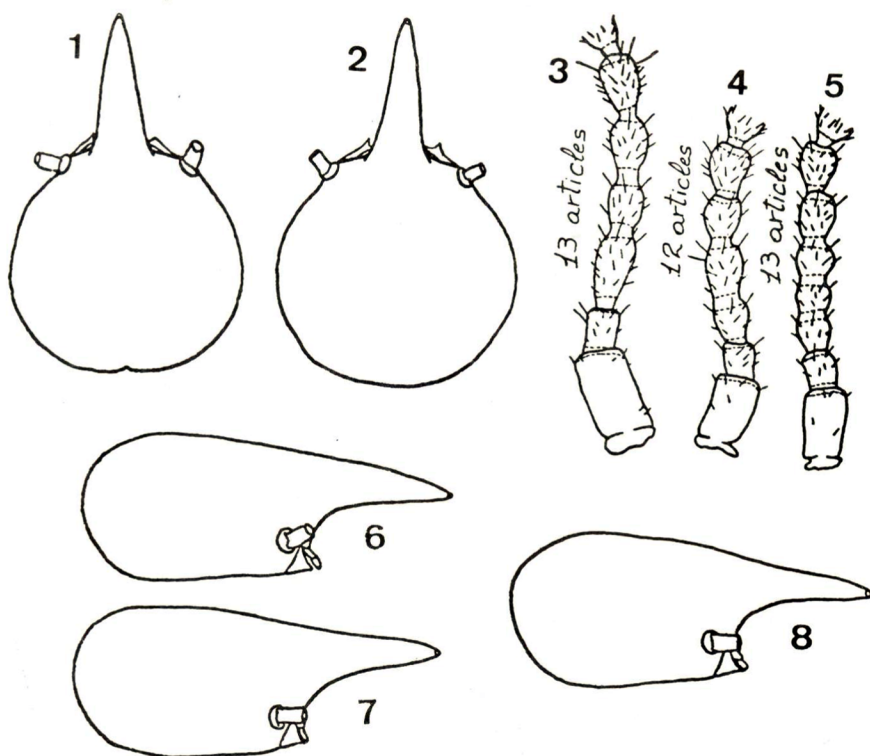
Nasutitermes aquilinus (Holmgren, 1910)

Nasutitermes aquilinus, Holmgren, 1910: 193-196 (soldier variation), 200 208, 217, 286-289 (imago, soldier, worker,) figs. 11 (soldier variation), 59a (imago) b-c (major soldier) d-e (minor soldier) [*Eutermes* (*Eutermes*)]; Strelnikov, 1920: 219-220 (nest), figs. 8-9, 11 (nest) (*Eutermes*); John, 1920: 230-231 (nest, locality) (*Eutermes*); Weidner, 1955: 107-108 (nest), figs. 12-13 (nest); 1966: 213 (nest); 1970: 41 (nest), figs. 60-61; Araujo, 1977: 40 (distribution). Type-locality: Itapocu, state of Santa Catarina, Brazil. Type: IFPP, ZIZM, Mus. Greifswald. Distribution: BRAZIL: states of Rio Grande do Sul, Santa Catarina, São Paulo, Rio de Janeiro (*n. loc.*), Minas Gerais; PARAGUAY; ARGENTINA (*n. loc.*).

Nasutitermes aquilinus rectifrons (Holmgren), 1910: 289 (soldier, worker) [*Eutermes* (*Eutermes*)]. Type-locality: state of Rio Grande do Sul, Brazil. Type: NHRM. New synonymy.

There seems to be no reason for maintaining *N. a. rectifrons*, name proposed for the specimens of the state of Rio Grande do Sul, Brazil, as some or all the peculiarities of the antenna and shape and size of the head of the soldier, which are held to be characteristic of the subspecies, are present to some extent in most of the samples from the other regions of Brazil.

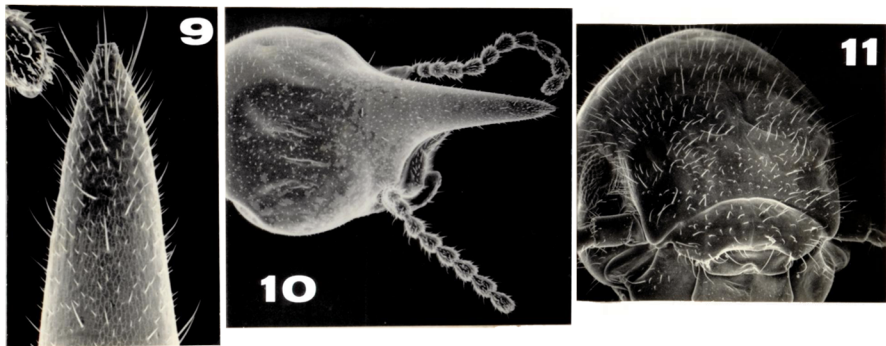
The imago-caste was described by Holmgren (1910: 286-289). No imago was present in the 41 samples studied.



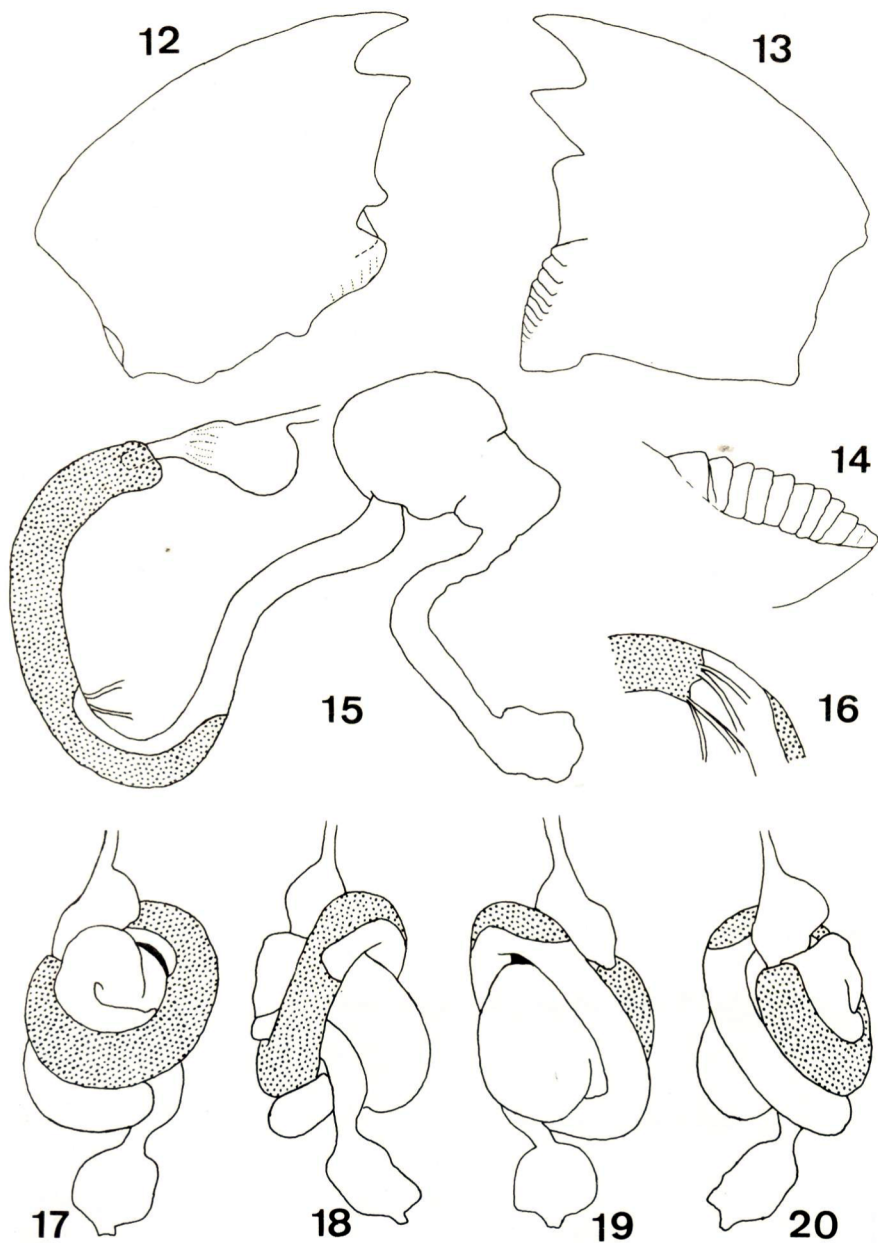
Soldier: 1-2, head, dorsal; 3-5, antennae of 3 specimens (length of head 2.48, 1.95 cm, respectively); 6-8, head, lateral. Figures based on specimens from sample 6459.

Soldier (figs. 1-10). Two sizes. Head yellow, very lightly brownish; apical 2/3 (or more) of nose yellowish- to reddish-brown, usually dark and contrasting strongly with the colour of the remainder of the cephalic capsule. Postmentum yellow. Antenna yellow, slightly brownish. Thoracic sclerites yellowish; anterior margin of pronotum darker, sometimes pale brownish. Abdominal sclerites transparent, yellowish. Legs yellowish-white. Head with scarce, short to moderately long bristles, and many very short hairs separated by a distance larger than their length (figs. 9-11). Thoracic sclerites not with hairs similar to those on head, scarcer on metathorax. Tergites with a subapical row of bristles and many hairs; bristles about the same length as those on head; hairs a little longer than those on head and separated by a distance a little larger than their length. Sternites with a subapical row of bristles and many hairs, both longer than those on tergites; hairs separated by a distance about as large as their length. Dorsal view of head (figs. 1-2): bulbous; sides convex; posterior margin convex, in the larger soldiers sometimes incised in the middle; nose conical. Lateral view of head (figs. 6-8): dorsal line almost straight to slightly convex; nose conical, distinctly enlarged at basal third. Antenna (figs. 3-5) with 13 (sometimes 12) articles; proportions between basal articles variable. Anterior margin of pronotum slightly or not emarginated in the middle. Mandibles with distinct small points.

Major worker. Head yellow to brownish-yellow. Thoracic sclerites, abdominal sclerites and legs pale yellow. Head with long bristles separated by a distance larger than their length, and many short hairs similar to the soldier and separated by a distance larger than their length. Tibial spurs 2:2:2. Width of postclypeus/length of postclypeus 2.00-2.42. Left mandible (fig. 12): index 0.5; A about as long as M1+2; posterior margin of A convex, longer than the anterior margin of M1+2; angle between A and M1+2 acute; cutting edge of M1+2 straight; no notch separating the cutting edge and M3; M3 developed, posterior margin convex; M4 visible in the gap between M3 and the molar prominence; molar prominence blunt, short, projecting a little beyond the tip of M3 and separated from it by a distance a little shorter than the width of M3. Right mandible (figs. 13-14): A and M1 as left A and M1+2; posterior margin of M1 longer than its anterior margin and about as long as the posterior margin of M2; M2 developed; angle between M1 and M2 acute; molar plate flat, without a basal indented outline, and with 9-11 ridges. Digestive tube (figs. 15-20): CP and G clearly visible in dorsal view (fig. 17); G armature in the posterior half of the crop-gizzard conjunct; SV long; MS mainly on the right half of the abdomen, passing ventrally beneath the crop (fig. 19); MS much longer than the width of M, a little shorter than M and P1; mesenteric portion of MS attenuated when joining the mid-gut strictly speaking; T (fig. 16) a little enlarged along MS, insertion and disposition as in the figure; P1 cylindrical, about as long as M, joining the dilated P3 on the right half of the abdomen; P2 dorso-



Soldier: 9, nose, dorsal; 10, head. Brachypterous neotenic: 11, head. Figures based on specimens from sample 7853.



Major worker: 12 left mandib'le; 13, right mandib'le; 14, right molar plate; 15-20, digestive tube (15, total; 16, detail to show Malpighian tubules; *in situ*: 17, dorsal 18; right; 19, ventral; 20, left). Figures based on specimens from sample 6459.

laterally placed (figs. 17-18), armature very weak (not examined in detail); C short, not bent anteriorad, and coiling downwards for a short distance after it leaves P3; R not very voluminous.

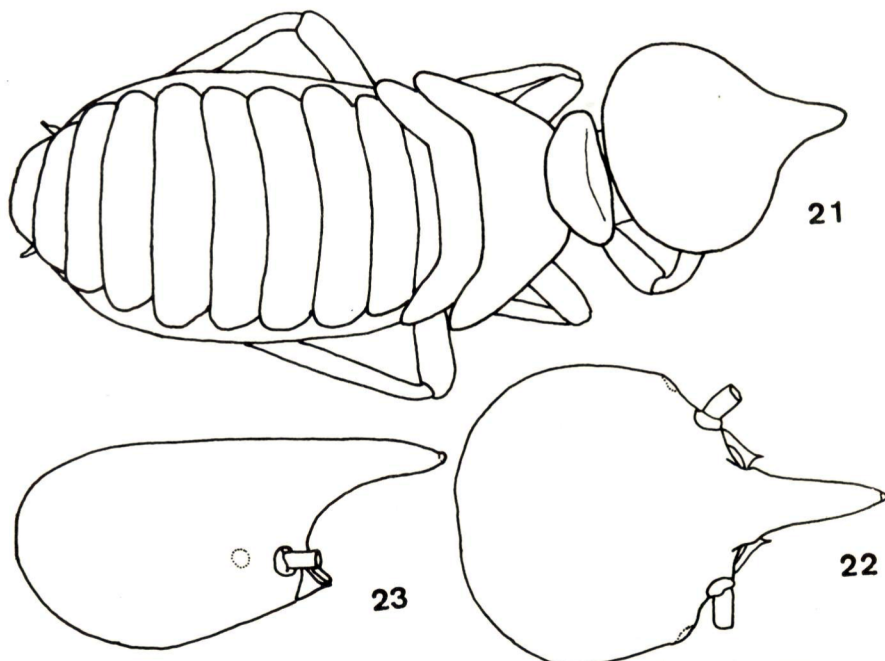
Minor worker. Similar to the major worker (digestive tube not compared) but paler.

Brachypterous neotenics (samples number 2838 and 7853) (fig. 11). Sclerites yellow to brownish-yellow. Head with many long and shorter bristles, separated by a distance shorter than their lengths. Eyes small but distinct, pigmented. Ocelli present. Fontanelle slit-like. Pronotum saddle-shaped. Wing buds small, sometimes almost undiscernible.

Variation. The size of the soldier head (figs. 24-25) seems to be the main feature of variation in this species; also the antenna (figs. 3-5) is very variable.

Measurements (in millimeters) of soldiers. The first two are based on several samples from different localities and the others on sample 7836. Length of head to tip of nose 1.61-2.57; width of head 1.00-1.82; length of nose 0.62-0.95; height of head excluding postmentum 0.80-1.25; width of pronotum 0.55-1.00; length of hind tibia 0.95-2.00.

Comparisons. The soldier of *N. aquilinus* is distinguished from all others of the genus by the colour and pilosity of the head and by the large size of the head of the major soldier. The worker mandibles of *N. aquilinus* are very similar to those of the type-species of the genus and species closely related to it, and appear to be adapted to feed on hard, woody materials (Sands & Lamb, 1975: 191, figs. 1-4). The coilings of the worker digestive tube of *N. aquilinus* look like those of *N. arborum* (Johnson, 1979: 34, figs. 3-4) and the small disagreements should be explained as variation between species or as the result of a different repletion of the gut components. The worker digestive tube of *Nasutitermes* sp., described by Kovoov (1969: 208-209, fig. 9), has the Malpighian tubules inserted exactly opposed to the mesenteric portion of MS, and different proportions between M, MS, P1 and C; differences in the worker gut of different species of the same genus are still poorly known to permit a discussion.



Soldier-nymph intercaste: 21, total; 22, head, dorsal; 23, head, lateral. Figures based on 1 specimen from sample 6459.

Material. The numbers refer to the MZSP collection, except for those marked BM(NH). BRAZIL. São Paulo: Campinas (22° 53' S, 47° 04' W), 0984 (Fazenda São Quirino), soldiers, workers, 14.VIII.1963, A. A. Rocha & J. S. Morgante; 3839 (Fazenda Mato Dentro), soldiers, workers, 3.V.1953, R. L. Araujo; 4855 soldiers, workers, 1.XII.1970, B. F. Amaral; Itapevi (23° 33' S, 46° 55' W), 1455, soldiers, workers, VI.1958, R. L. Araujo; Itu (23° 16' S, 47° 17' W), 4696 (Fazenda Pau d'Alho), soldiers, workers, 21.X.1958, R. L. Araujo; Jarinu (23° 05' S, 46° 43' W), 2837 BM (NH) 1962-235), 2838, 2843 soldiers, workers, brachypterous netenics, nymphs, larvae, eggs, II-III.1945, V. Autuori; Leme (22° 11' S, 47° 23' W) (Ribeirão do Zumba), 2875, 2876 (BM (NH) 1960-182), soldiers, workers, 16.V.1945, R. L. Araujo; Mogi-Guaçu (22° 24' S, 46° 56' W) (Fazenda Campininha), 7611, soldiers, workers, 3.VIII.1978, L. R. Fontes; 7853, soldiers, workers, brachypterous netenics, nymphs, larvae, eggs, 29.VI.1979 L. R. Fontes & P. S. Terra; Piraju (23° 11' S, 49° 22' W), 1641, soldiers, workers, 25.II.1968, M. Carrera; São Paulo (23° 31' S, 46° 36' W), 1513 (Universidade de São Paulo), soldiers, workers, X.1969, I. Minura; 1583, soldiers, workers, VIII.1921, Kähler; 7836 (Universidade de São Paulo), soldiers, workers, nymph, 5.IV.1979, L. R. Fontes & P. S. Terra & A. E. Migotto; São Vicente (23° 59' S, 46° 22' W) (Ilha Porchat), 2889, 2903, soldiers, workers, IX.1945, R. L. Araujo; Tapiraí (28° 58' S, 47° 33' W), 1658, soldiers, workers, II.1968, F. Lane. Rio de Janeiro: Ilha Grande (23° 10' S, 44° 15' W), BM (NH) 1962-235, soldiers, workers, 9.X.1944, H. Muth & H. Sick; Rio de Janeiro (22° 55' S, 43° 30' W), 7852 (Jacarepaguá: Represa do Cigano), soldiers, workers, 23.V.1974, Argenti & Sandini. Minas Gerais: Arceburgo (21° 21' S, 46° 56' W), 3385 (Fazenda Fortaleza), soldiers, workers, 19.VIII.1951, P. Freitas; Belo Horizonte (19° 54' S, 43° 56' W), 1653 (Instituto de Botânica), soldiers, workers, 11.I.1965, J. S. Morgante; Campanha (21° 56' S, 45° 50' W), 2944, soldiers, workers, IX.1945, R. L. Araujo; Poços de Caldas (21° 47' S, 46° 33' W), 0540 (Cascata das Antas), soldiers, workers, 11.IX.1967, R. L. Araujo; Santa Barbara do Tugúrio (21° 14' S, 43° 43' W), 6241, soldiers, workers, larvae 1.VIII.1975, R. L. Araujo. Santa Catarina: Blumenau (26° 55' S, 49° 03' W), 0347, soldiers, workers, larvae, 25.II.1968, R. L. Araujo; Corupá (26° 10' S, 49° 36' W), soldiers, workers 1902, W. Ehrhardt; Itapocu (26° 33' S, 48° 42' W), 6459, 5475, soldiers, workers, nymphs, larvae 22.XII.1975, R. L. Araujo; São Miguel do Oeste (26° 45' S, 53° 35' W), 6468, soldiers, workers, 27.XII.1975, R. L. Araujo. Rio Grande do Sul: Santa Maria (29° 47' S, 53° 42' W), 1500, 1507, soldiers, workers, IV-V.1967, D. Link; São Leopoldo (29° 51' S, 51° 07' W), 1542 soldiers workers, nymphs, 17.IX.1966, H. Reichardt; 2106, soldiers, workers, nymphs eggs, 3.VIII.1969, R. L. Araujo; 2109 soldiers, workers, 3.VIII.1969, R. L. Araujo; Sapiranga (29° 43' S, 51° 00' W), 1600, 1604, soldiers, workers, nymphs, 24.VII.1975, Exp. Depto. Zool. ARGENTINA. Misiones: Bemberg (?), BM (NH) 1962-235, 2 soldiers, 1 worker, 12-29.I.1945, Hayward & Golbach. PARAGUAY. Rio Monday (25° 35' S, 54° 35' - 55° 25' W) (Juanita), BM (NH) 1962-242, 2 soldiers 3 workers, 2 nymphs, 7.V.1915, O. John.

THE SOLDIER-NYPH INTERCASTE

In the Termitidae soldier-nymph intercastes are known in the *Microcerotermes* (Adamson, 1940: 45-48; Gay, 1952: 127-128), *Termes* (Noirot, 1955: 570-572; 338-339), *Nasutitermes* (Adamson, 1940: 36-45), *Tumulitermes* (Gay, 1968: 83-84), *Cubitermes* (Bouillon & Mathot, 1964: 221-223), and *Amitermes* (Gay & Watson, 1974: 38). The significance of termite intercastes is discussed by Adamson (*l. c.*: 4952) and Noirot (1955: 568-572) and, in all cases, their occurrence appears to be restricted to a few individuals.

In *Nasutitermes* only one specimen of this intercaste is known from *N. guayanae*, described in detail by Adamson (*l. c.*), and which is more closely related to the imago-caste than those of *N. aquilinus*.

In *N. aquilinus* 2 specimens of this intercaste were discovered in sample number 6469, and 1 in sample number 7836.

Description of the intercaste (number 7836) (Figs. 21-23). Colour similar to soldier, except for the dark eye spots and whitish abdominal contents; wing buds yellowish. Pilosity soldier-like; wing buds with short dense pilosity. Shape of head soldier-like; nose somewhat distorted; ocular prominences and ocelli

FIGURE 24

Frequency distribution of the
length of the head of 351
soldiers

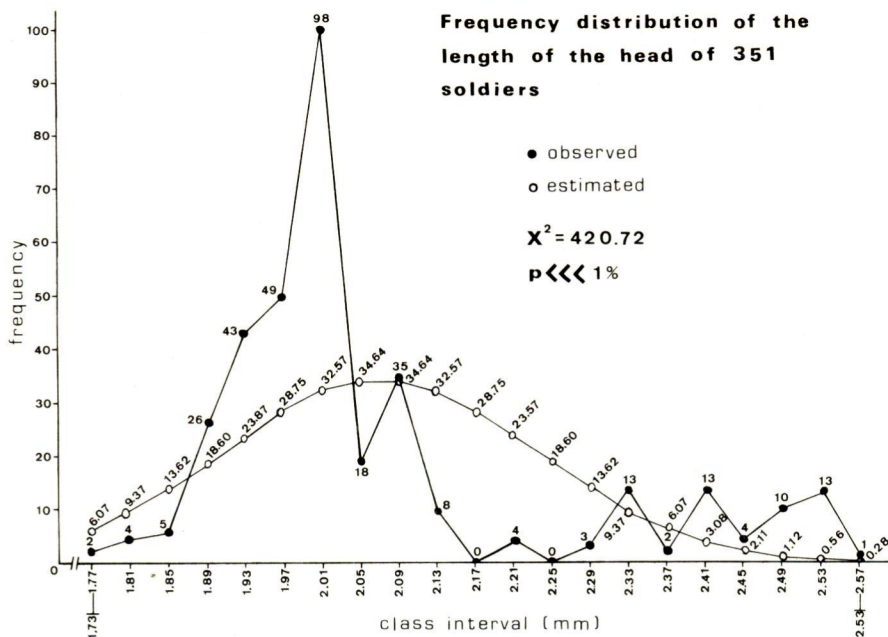
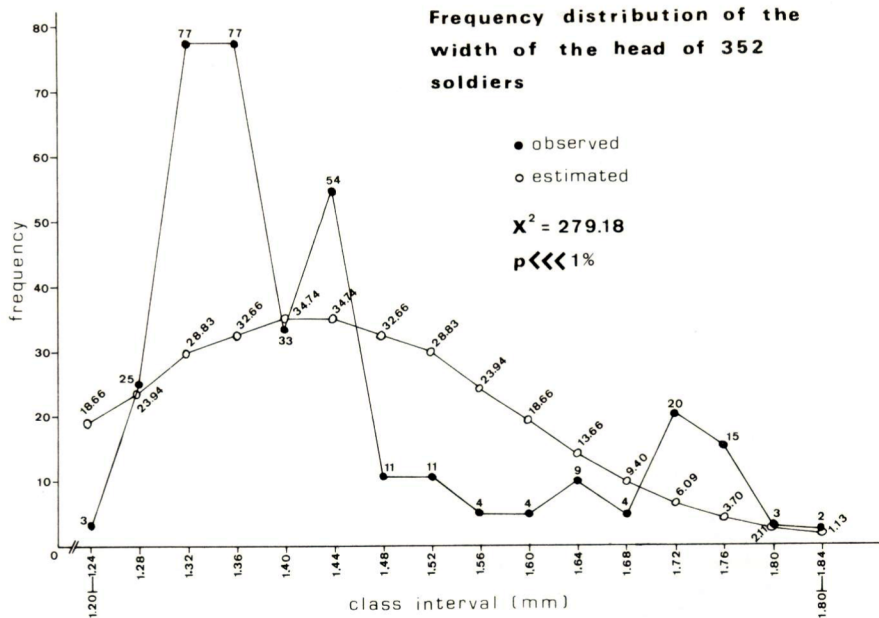


FIGURE 25

Frequency distribution of the
width of the head of 352
soldiers



present. Mouthparts soldier-like. Antenna with 14 articles: II-IV about the same length; I-III a little narrower than IV. Pronotum wide; anterior margin less pronounced than in the soldier. Meso- and metathorax with developed wing buds; these with rudimentary venation. Abdomen larger than in the soldier.

The 3 other specimens (sample 6459) have a less remarkable set of nymphal characteristics than that described above. One has small wing buds on the meso- and metathorax, and scarcely pigmented ocular prominences; also the posterior margin of the head is deeply emarginated in the middle. The 2 others have a somewhat prominent or pointed sides of mesothorax, which has no wing buds: one has small wing buds on the metathorax, ocular prominences pigmented only in the middle, and the seventh sternite somewhat female-like; the other has a single, small wing bud on the left side of the metathorax, and the right side somewhat pointed. The other characteristics of these specimens are soldier-like.

Measurements (in millimeters) of the 4 intercastes (the first column is of the specimen of colony number 6459):

Length of head with nose	2.32	2.40	2.40	2.37
Width of head	1.55	1.70	1.75	1.70
Height of head				
excluding postmentum	1.00	1.07	1.05	1.00
Length of head without nose	1.52	1.50	1.50	1.55
Width of pronotum	1.00	0.87	0.90	0.95
Length of hind tibia	1.77	1.90	1.80	1.87

BIOMETRICS

The statistics presented in figures 24-25 were based on specimens of colony 7836 and show the existence of two types of soldiers in the population as already noted by Holmgren (1910: 193-196, fig. 11). They apparently differ only in size, and we noticed no difference in the behaviour when collecting.

If one compares our results with those of Holmgren (*l. c.*), the differences in range of variation and in major/minor soldier percentage may be explained by the number of specimens measured and/or by regional population peculiarities. Sample were not measured for percentages, as they were not collected for this purpose.

DISTRIBUTION, NEST AND BIOLOGY

Nasutitermes aquilinus inhabits the evergreen tropical forests and gallery forests distributed over southeastern South America, being known from Brazil, Argentina (not included in fig. 26) and Paraguay. In Brazil, it was not found in the Cerrado and Campo vegetations that may border those forests, and is also absent from the exuberant Restinga vegetation of the littoral of the state of São Paulo, which has 4 species of *Nasutitermes*.

Specimens are found in dead trunks and arboreal nests. In a single occasion termites were collected in covered galleries inside a house (sample number 2944); some nests were found in dead *Eucalyptus* trunks and fence posts.

N. aquilinus probably has a wood dwelling habit during the initial phase of colony establishment, as an incipient nest consists of a mass of carton material protruding from the surface of a standing dead trunk hardly infested by the termite.

A large nest is globose, from a few centimeters up to 2 meters above ground level, large to very large (diameter up to 1 m), brown to dark brown, and frequently has lichens and mosses on the surface. Four layers of carton material can be recognized: (I) a fine and continuous superficial envelope weakly attached to the following layer; (II) a layer of large and flat chambers, which communicate broadly with each other (fig. 32); the chamber walls are thin, sometimes with perforations about as wide as the termites, and the outermost ones have pin-like structures on the raised corners (fig. 29) or on the surface (fig. 33), for the attachment of the thin covering layer (I); (III) a layer of small round

chambers with thick walls (fig. 34); it constitutes a considerable portion of the nest and is very hard to destroy; (IV) a nuclear set of flat chambers with darker and very thin walls (fig. 30).

Two nests were explored:

a, sample number 7853 (figs. 27-30). This typical nest, in a trunk 11 cm in diameter, was 1.80 m above ground level, 49 cm high, 27 x 32 cm wide, and surrounded a dead trunk (diameter of about 7 cm) nearby partially infested by the termite, 2 living climbing plants (diameter of 1 and 1.5 cm), 20 cm of which were 4 cm deep in the nest, and another climbing plant (diameter of 5 cm) deeply immersed in the nest. Measurements of the internal layers: layer II 2-4 cm wide; layer III 5-7 cm wide; layer IV about 13 cm wide and 25-30 cm high. Approximate weight: 24 kilogramms. Covered galleries 0.5-1.5 cm wide connected the nest to the ground. After being completely and minutely explored in search of the royal pair, the nest showed no trace of a royal chamber and only a countless amount of brachypterous neotenic reproductives and many chambers full of eggs were discovered.

b, sample number 7836 (figs. 31-34). A mushroom-like nest. The nest, which surrounded its low support trunk with a diameter of 41 cm, was only 3 to 10 cm above ground level, 1.35 m high, and had a circumference of 5.30 m (diameter of about 1.70 m). After a morning of work with heavy tools about 1/4 of the nest was excavated, and the following measures of layer II were taken: width at the sides of the nest 23-29 cm; width on the top of the nest 82 cm; width at the bottom of the nest 10 (or less) cm. Most of the nest surface was covered with *Tradescantia* (Commelinaceae) and mosses and, in spite of its large size, it was hardly discernible from the surrounding vegetation (fig. 31).

Specimens were observed in activity in both nests described above. One or 2 minutes after removing the cover layer (I) soldiers appear in the openings of the galleries and chambers; they do not venture outside, but remain in the edge

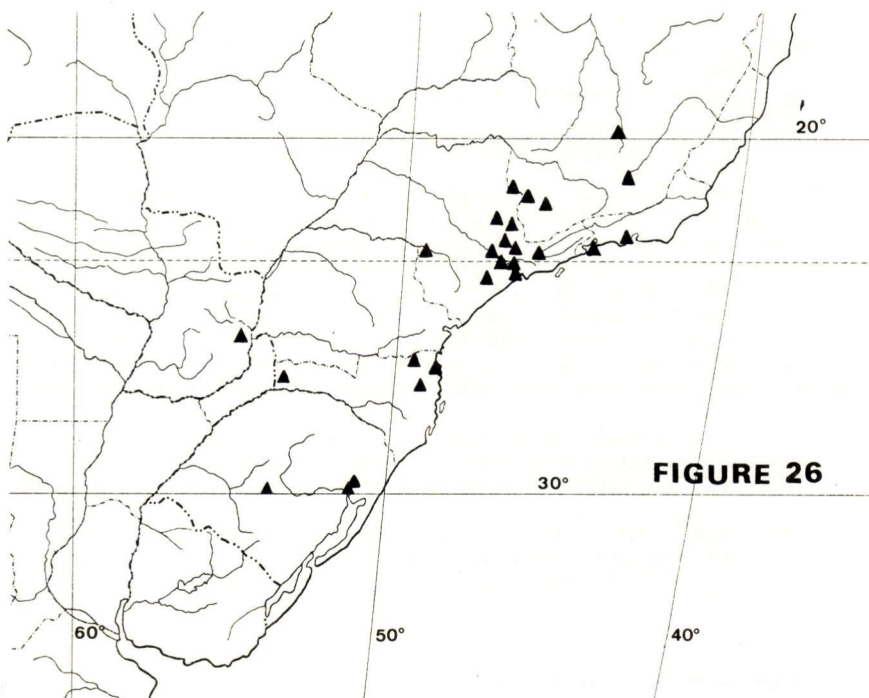
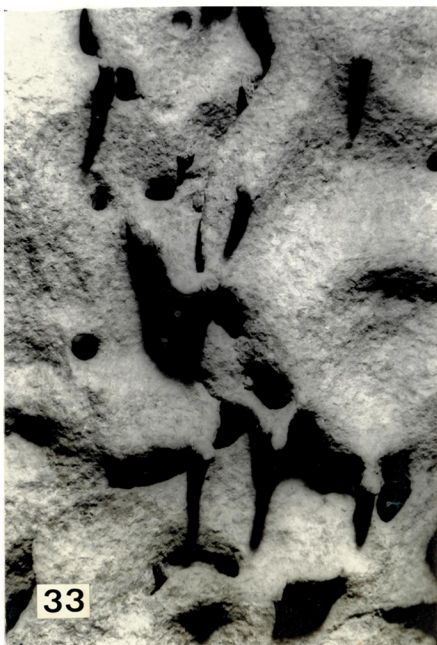


Fig. 26, distribution of *N. aquilinus*; Bemberg (?), Argentina, is not included.



Nest (sample 7853): 27, total view cover layer damaged; 28, longitudinal section; 29, layer II showing raised corners with pin-like processes for the attachment of the cover layer; 30, detail of the nuclear region (layer IV).



Nest (sample 7836): arrow indicates the centre of the giant nest completely covered with plants, inside forest; 32, layer II viewed from above; 33, detail of layer II showing pin-like processes (made evident by the shadows) for the attachment of the cover layer; 34, layer III (note the round chambers with thick walls).

of the breach almost only the head visible from the outside. Workers arrive later, examine the area with the antennae, turn round and defecate; if a worker holds some particle with the mandibles, after defecating it turns round again and cements the particle with the faeces. Half an hour later a thin wall of faeces and particles closes the chambers. The easily detachable cover layer (I) will appear only some days later.

TERMITOPHILES

Five species of termitophilous Staphylinidae (Coleoptera) are known to occur with *N. aquilinus* (Seevers, 1957: 303), some of which may prove to be host specific: *Xenogaster inflata* (reported also in association with *N. itapocuensis*), *Termitohospes brasiliensis*, *T. sivestrii*, *Termitopithus crassiusculus*, and *Termitosyne platygastera*. The following new records are given for *Termitosyne platygastera*, in addition to those of Seevers (l. c.: 82): 1 specimen, sample number 6475. Itapocu, state of Santa Catarina, Brazil; 4 specimens, sample number 7853, Mogi-Guaçu (Fazenda Campininha), state of São Paulo, Brazil.

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REFERENCES

- Adamson, A. M., 1940. New termite intercastes. *Proc. Roy. Soc. London*, ser. B, 129: 35-53.
- Araujo, R. L., 1977. *Catálogo dos Isoptera do Novo Mundo*. Rio de Janeiro, Academia Brasileira de Ciências, 92 pp.
- Bouillon, A. & G. Mathot, 1964. Observation sur l'ecologie et le nid de *Cubitermes exiguus*. Description des nymphes-soldats et d'un pseudimago. In Bouillon, A. (ed), *Etudes sur les termites africaines*, Masson, Paris, pp. 215-230.
- Fontes, L. R., 1980. *Caetermes taquarussu*, a new genus of Ecuadorian nasute (Isoptera, Termitidae, Nasutitermitinae). *Rev. bras. Ent.* 24 (4): 131-136.
- Gay, F. J., 1952. A rare termite intercaste. *Aust. J. Sci.* 14: 127-128.
- Gay, F. J., 1968. Soldier-reproductive intercastes in a species of *Tumulitermes* (Isoptera, Termitidae). *J. Aust. Ent. Soc.* 7: 83-84.
- Gay, F. J. & J. A. L. Watson, 1974. Isoptera. In CSIRO, *Insects of Australia*, Australia, Melbourne University Press, Supplement, pp. 37-39.
- Holmgren, N., 1910. Versuch einer Monographie der amerikanischen *Eutermes*-Arten. *Jahrb. Hamb. wiss. Anst.* 27 (2): 171-235.
- John, O., 1920. South American termites. Additional note to Mr. I. Strelnikov's article on. *Bull. Inst. Sci. Lesshaft* 1: 227-234.
- Johnson, R. A., 1979. Configuration of the digestive tube as an aid to identification of worker Termitidae (Isoptera). *Syst. Ent.* (1979) 4: 31-38.
- Kovoor, J. 1969. Anatomic comparée du tube digestif des termites. II. Sous famille des Nasutitermitinae. *Insectes Sociaux*, Paris, 16 (3): 195-234.
- Noirot, C., 1955. Recherches sur le polymorphisme des termites supérieurs (Termitidae). *Ann. Sci. Nat. Zool. Biol. Animale* 17 (11): 399-592.

- Noirot, C., 1969. Formation of castes in the higher termites. In Krishna, K. & F. M. Weesner (eds.), *Biology of termites 1*. Academic Press, N. York & London, pp. 311-350.
- Sands, W. A. & R. W. Lamb, 1975. The systematic position of *Kaudernitermes* gen. n. (Isoptera, Termitidae, Nasutitermitirae) and its relevance to host relationships of termitophilous staphylinid beetles. *J. Ent. (B)* 44 (2): 189-200.
- Seevers, C. H., 1957. A monograph on the termitophilous Staphylinidae (Coleoptera), *Fieldiana: Zoology* 40: 1-334.
- Strelnikov, I. D., 1920. (On South American termites, of Paraguay, Matto Grosso (Brazil) and Chiquitos (Bolivia) (In Russian). *Bull. Inst. Sci. Lesshaft* 1: 215-226.
- Weidner H., 1955. Termitennester. In Schmidt (ed.), *Die Termiten, ihre Erkennungsmerkmale und wirtschaftliche Bedeutung*, Leipzig, Akademische Verlagsgesellschaft Geest & Portig K-G, pp. 82-120.
- Weidner, H. 1966. Die entomologischen Sammlungen des Zoologischen Staatstinstitut und Zoologischen Museums Hamburg. VI Teil, Insecta III. *Mitt. Hamburg. Zool. Mus. Inst.* 63: 209-264.
- Weidner, H., 1970. Isoptera (Termiten). In Helmcke, J. et alii (eds.), *Handbuch der Zoologie*, Berlin Gruyter, 4 (2) 2/14, pp. 1-147.